COURSE CODE:	VCH 502
COURSE TITLE:	Zoonoses And Environmental Health
NUMBER OF UNITS:	2 Units
COURSE DURATION:	Two hours per week

COURSE DETAILS:

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COURSE CONTENT:

Concepts, definitions and classification of zoonoses

Study of specific bacterial, viral, rickettsial, protozoan and fungal zoonoses with emphasis on early detection, prevention, control and eradication

Health implications of zoonotic diseases and contaminants in food of animal origin

Public health significance of rodents, birds and insects. Control methods and surveillance

Water sources and environmental pollution

Waste management with emphasis on disposal and utilization e.g. biogas production

COURSE REQUIREMENTS:

This is a compulsory course for all 500 level students in the college of Veterinary Medicine. In view of this, students are expected to participate in all course activities and have minimum of 70% attendance to be able to write the final examination

LECTURE NOTES

Concepts, Definitions and Classification of Zoonoses

Zoonoses are among the most frequent and dreaded risks to which mankind is exposed. Human beings have always had contact with animals, relying on them for food, transport, draft-power, labour and companionship. But the domestication of animals also brings along with it the opportunities for the passage of pathogens from animals to man and *vice versa.* It is often believed that most of the infections which pose challenge to human health and welfare, originate either from animals directly or through their products and by-products.

World Health Organization (WHO) in 1959 defined Zoonoses as *"those diseases and infections that are naturally transmitted between vertebrate are animals and man"*. Thus zoonoses are two or more hosts per one infectious agent system in which one of the hosts happen to be man. Zoonoses are thus interesting not only because of their relevance to human health, but because they are high profile models for multi-host infectious diseases in general.

Some humans are mostly at risk than others; like infants and small children (with immature immune systems, poor hygiene), pregnant women (immune systems are more susceptible and there are additional fatal hazards), elderly persons (whose immune systems may be impaired), immune-compromised people (undergoing cancer therapy, AIDS/HIV patients etc.), people who have received organ or bone marrow transplant, people born with congenital immune deficiencies. Veterinarians, farm workers, zoo/wildlife workers and other animal health care workers.

Zoonosis has been a social and economic burden. Zoonoses stunt the economic growth of the countries where they are endemic and inhibit the generation of capital needed for investments. The developing countries suffer much greater losses than the technically advanced countries. Besides causing economic losses (related to

treatment, zoonoses cause considerable loss of livestock, their productivity (dairy product, animal products and by-product industry) and reproductivity. Thus, zoonoses act as a "double-edge weapon" affecting both social fabric and economic development of a country.

The socio-economic losses from zoonoses, though significant, are difficult to quantify completely because, as with other human diseases, the actual cost in terms of lives and suffering cannot be measured. The losses in export and investment opportunities and the consequent losses in foreign exchange sustained by countries because of zoonoses cannot be estimated.

The following (not fully exhaustive though) are impact zoonotic diseases can have on a given human population:

1. Acute or chronic debilitating illness
2. Impairment of productivity
3. Mortality
4. Reduced reproductivity
5. Loss of man-hours
6. Monetary/financial loss (for diagnosis, treatment, surveillance and control)
7. Adverse effect on morale of personnel
8. Unfavourable publicity
9. Loss of export and foreign exchange

Classification of Zoonoses

The enormity of zoonotic problems and complex epidemiological patterns of zoonoses necessitate their classification into suitable groups so as to facilitate their diagnosis and management. A number of approaches have been adopted to classify zoonotic infections.

A. According to the Type of Causative/Aetiological Agents

Zoonoses can be classified according to the type of causative/aetiological agents are follows:

i. Viral zoonoses caused by virus e.g. rabies
ii. Bacterial zoonoses caused by bacteria e.g. anthrax, brucellosis
iii. Rickettsial zoonoses caused by rickettsia e.g. Q-fever
iv. Chlamydial zoonoses caused by Chlamydia e.g. *Chlamydia psittaci*
v. Mycotic zoonoses caused by fungi e.g. Aspergillosis, ringworm
vi. Protozoan zoonoses caused by protozoa e.g. Ameobiasis, toxoplasmosis
vii. Helminthic zoonoses caused by helminth parasites e.g. Taeniasis, schistosomiasis
viii. Ectoparasitic zoonoses caused by ectoparasites e.g. scabies, myiasis

B. **According to the Reservoir Host/Direction of Transmission**

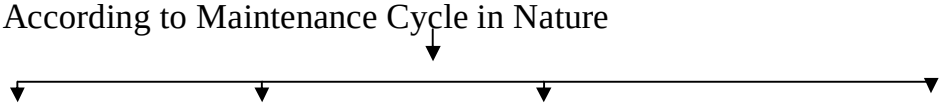
i. ***Anthropozoonosis***: are diseases transmitted from animals (lower vertebrates) to man e.g. anthrax, brucellosis, tuberculosis, rabies etc
ii. ***Zooanthroponosis***: are human diseases shared naturally by animals or transmitted to lower vertebrate animals, e.g. diphtheria, human type tuberculosis, infectious hepatitis, measles etc.
iii. ***Amphixenosis***: this is a situation whereby infection is maintained in both man and lower vertebrate animals and may be transmitted in either direction, e.g. staphylococcosis, salmonellosis, *E. coli* infection

In the East-European countries, the animal to man transmission is described as zooanthroponosis, and man to animal transmission is described as anthropozoonosis.

C. According to Maintenance of Cycle in Nature/Live Cycle of the Agent

This classification is considered to be of immense epidemiological value and useful in developing appropriate strategies for zoonoses management.

Zoonoses According to Maintenance Cycle in Nature



Direct Zoonoses	Cyclo-zoonoses	Meta-zoonoses	Sapro-zoonosis
Direct Anthropozoonosis	Obligatory Cyclo-zoonoses	Sub-type 1: Meta-zoonosis	Sapro-anthropozoonosis
Direct Zooanthropozoonosis	Non-obligatory Cyclo-zoonoses	Sub-type II Meta-zoonosis	Sapro-anthropozoonosis
Direct Amphixenosis		Sub-type III: Meta-zoonosis	Sapro-meta-anthropozoonosis
		Sub-type IV: Meta-zoonosis	Sapro-cyclo-zoonosis

1. *Direct Zoonoses*: these are zoonoses that can be perpetuated in nature by a single vertebrate species. These are transmitted from an infected vertebrate host to a susceptible host by contact, vehicle or mechanical vector. The agent itself undergoes little or no propagative change during transmission, e.g. chlamydiosis, glanders, leptospirosis, ringworm, rabies, brucellosis, pasturellosis, staphylococcus etc.

The direct zoonoses may be of the following types;

a) *Direct anthropozoonosis*, in which the lower vertebrates (various species of domestic and wild vertebrate animals) are the reservoir host of the infectious

agents and human involvement often occurs only through accidental exposures. These infections can exist in nature independently of man.

b) *Direct zooanthroponosis*: this includes those diseases which normally are transmitted from man to man but which may occasionally infect lower vertebrates, e.g. tuberculosis, diphtheria etc.

c) *Direct amphixenosis*: some zoonotic infections may be maintained in nature either by lower vertebrate animals or by man. Transmission may occur in either or both directions. Man and lower vertebrates are equally suitable reservoir hosts and infection can occur in the absence of one or the other, e.g. staphylococcosis

2. *Cyclo-zoonosis:* Here, more than one vertebrate host, but no invertebrate host is required for completion of the agent's developmental cycle, e.g. tapeworm infection, hydatidosis etc. It may be obligatory or non-obligatory.
   a) *Obligatory cyclo-zoonoses:* man must be one of the vertebrate host e.g. *Taenia saginata* infection
   b) *Non-obligatory cyclo-zoonoses*: human involvement may not be involved, e.g. hydatidosis
3. *Meta-zoonoses*: here, cycle required both vertebrates and invertebrates, and are transmitted biologically by invertebrate vectors. The invertebrate host may or may not serve as a reservoir of infection.
4. *Sapro-zoonoses*, require a non-animal site to serve either as a true reservoir of infection or as site for an essential phase of development, besides vertebrate host. The inanimate site may be organic matter, water, food, soil or plants. The agent may propagate in the non-animate site (propagative or cyclopropagative) e.g. histoplasmosis, or may undergo essential development without propagation (developmental stage) e.g. *Ancylostoma braziliensis*
   a) Sapro-anthropozoonosis: here infection is normally transmitted between a lower vertebrate and a non-animate site and human involvement is only accidental, e.g. erysipeloid.

b) Sapro-amphixenosis: man and lower vertebrates are equally susceptible host and infection can occur in the absence of one or another, e.g. histoplasmosis

c) Sapro-meta-anthropozoonosis: this requires both an invertebrate host as well as a non-animate site in their transmission cycle, e.g. fascioliasis

D. According to Mode of Transmission

Zoonoses can be transmitted in many ways:

1. Contact-borne, e.g. brucellosis
2. Food and water-borne, e.g. *E. coli* infection, *Vibrio cholera*
3. Air-borne, e.g. anthrax
4. Vector-borne

a) *Mechanical*; carry the infectious agent on their body parts to susceptible host, e.g. anthrax, colibacillosis

b) *Biological*; in which the infectous agent undergoes some biological transformation before infecting the host

i) Propagative; if the agent multiples in the vector before being injected into the host, e.g. yellow fever

ii) Cyclo-propagative: if the agent develops and undergoes cyclic changes within the vector e.g. dirofilariosis

c) *Trans-ovarian*: the infection may be transmitted in vectors vertically from one generation to the next, e.g. Rift valley fever

d) *Trans-stadial*: the infection may be transmitted in vectors from stage to stage.

Zoonoses as "*those diseases and infections that are naturally transmitted between vertebrate are animals and man"*.

The following (not fully exhaustive though) are impact zoonotic diseases can have on a given human population:

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SPECIFIC BACTERIAL ZOONOSIS

Tuberculosis

This is a chronic bacterial disease of cattle, swine, sheep, goats and human caused by *mycobacterium spp*.

Horses, dogs and poultry are also susceptible, while wild animals which live in the wild are less susceptible to tuberculosis. However animals in captivity suffer from the infection, since it is mainly a disease of overcrowding.

The prevalence of cattle tuberculosis range from 2 – 14% in slaughtered cattle. Humans acquire the infection by inhalation, ingestion, and it could be also due to occupational hazards. The initial infection usually goes unnoticed.

Tuberculosis sensitivity appears within a few weeks. Lesions commonly heal leaving individual changes except occasional pulmonary or tracheo-brachial lymph-node calcification. Approximately 95% of those initially affected enter this latent phase, and may have life-long risk of reactivation.

In about 5%, the initial infection may progress directly to pulmonary tuberculosis or by lympho-haematogenous dissemination of bacilli to pulmonary, miliary, meningeal or other extra pulmonary involvement.

Serious outcome of the initial infection is more frequent in infants, very old and immunocompromised adults.

Extra pulmonary tuberculosis is much less common than pulmonary, e.g. bones and joints, larynx, skin, intestines, peritoneum and eyes.

Infectious agents

Mycobacterium tuberculosis and *Mycobacterium africanum* primary for humans.

M. bovis for cattle, *M. avium*, for poultry

Occurrence

Worldwide, but more common in developing countries; but even in developed countries, morbidity is high in areas and population groups with high prevalence of HIV infection.

Mortality and Morbidity rates increase with age, and in older persons, they are higher in males than females.

It is much higher among the poor than the rich.

Avian Tuberculosis

This is due primarily to *M. avium*. Poultry TB has been reported in Nigeria and more likely to occur in old birds, especially old layers. Turkey is also susceptible to *M. avium* infection though not commonly reported. It can also affect humans.

Incubation period of Tuberculosis is about 4 to 12 weeks, while the subsequent risk of progressing from pulmonary to extra pulmonary is greatest within the first 2 years after infection and it may persist a lifetime as a latent infection.

Clinical Manifestation of Tuberculosis

There is initial fatigue, fever & weight loss with localizing symptoms of cough, chest pain, hemoptysis, and hoarseness which becomes prominent in advanced stages.

Diagnosis

Diagnosis of current active disease is made by demonstration of acid fast bacilli in stained smear from the sputum or other body fluid.

Confirmation of the disease is by isolation of the tubercule bacilli on culture, this is also useful in the determination of drug susceptibility of the infective organism.

Prevention and Control

- Avoid overcrowding which is the major predisposing factor.
- Pasteurization of milk before consumption
- BCG vaccine administration in man as preventive measure
- Detection and slaughter policy in affected herds: Detection is done by injecting Purified Protein Derivative(PPD).

Anthrax

This is a gram positive bacterial zoonoses primarily of ruminants but infective to man.

Aetiology: *Bacillus anthracis*

In humans, it causes a hyper acute infectious disease characterized by fever, septicemia, and rapid death. It localizes in skin causing malignant pustules or malignant cabuncles

If the spores of anthrax are inhaled by human beings, there may be fatal pneumonia or what is regarded as Wool Sorters Disease. It may also assume Acute Meningitis Syndrome following either cutaneous or respiratory infection.

Intestinal form of anthrax may follow consumption of contaminated meat.

Diagnosis: Signs on dead animals e.g. blood oozing out of orifices, no rigor mortis. Blood doesn't clot and the animal is bloated.

Laboratory diagnosis: Demonstration of causative organism in blood

Control:

- Ensure you have provision for rapid diagnosis
- Do an immediate destruction of an opened carcass of animals, either by incineration or deep burial with lime.
- Vaccinate cattle annually; but with vaccination, avoid treating animals with penicillin, which knocks off the effect of vaccine.

- Education of the agricultural populations to report any sign of the disease. If any farm is suspected, effect a quarantine, if infected animals were moved away from an area or slab, disinfect with lime or put petrol or diesel or kerosene in the area and burn with rags.

Glanders

This is a highly communicable disease of horse, mules or donkeys.

Human infection can occur, but rarely and if it occurs, it is usually fatal.

Aetiology: *Malleomysis mallei or Pseudomonas mallei*

Diagnosis: Organism Isolation and characterization

Colibacilosis

Synonym: Colibacteriosis /Colitoxaemia /White Scours.

Etiology:*Escherichia coli*

This is a major cause of traveller's diarrhea, and the diarrhea causing *E. Coli* are of 5 major categories: Enterotoxigenic, Enteropathogenic, Enteroinvasive, Enterohaemorrhagic, Enteroaggregative

Each has a different pathogenicity, possesses distinct virulence, properties and comprises a separate serotype, differing clinical syndromes and epidemiologic patterns.

Diarrhea Caused by Enterohaemorrhagic (EHEC)

It is characterized by intestinal toxemia, and the commonest serotype is 0157H7 which causes bloody diarrhea in infants and the aged. It has also been linked to Hemolytic Uremic Syndrome. Other serotypes such as O 26: H11 and O111: H8 have been implicated.

Hosts: Cattle and Horses, although it may be shed by dogs and all domestic animals.

Mode of Transmission: Transmission occurs by means of contaminated food, most often poorly cooked beef. Transmission by direct contact may occur in high risk populations.

Diagnosis: is by demonstrating the presence of Shiga-like toxins, by serotyping (e.g. identifying characteristic serotypes) or by DNA probes that identify the toxins genes or the presence of the EHEC plasmid.

Prevention and Control: Similar to that of Salmonellosis.

Tetanus/ Lockjaw

Aetiology: *Clostridium tetani*

Found in the soil and in animals and human faeces. It is more common in the tropics than in the cold climate. Horses are the most affected, although sheep, goat and cattle can develop the disease. All herbivores are primarily susceptible to infection.

The disease in man is characterized by tonic spasm of masseter muscles and other muscles. The reflexes are exaggerated and convulsion may occur.

The disease in animals is similar in signs and symptoms as in humans. The major source of infection is through wounds and during routine procedures like dehorning, shaving and tail docking. Iatrogenic tetanus can also occur during routine procedures like castration.

Both animals and man may contribute to the contaminated environment, since the organism is a normal inhabitant of the soil.

Prevention & Control: Immunization plays an important role in prevention. Wounds should be handled aseptically, and operations such as dehorning, docking, and castration should be carried out aseptically.

HEALTH IMPLICATIONS OF ZOONOTIC DISEASES

Zoonoses are among the most frequent and dreaded risks to which mankind are exposed. Human beings have always contact with animals, relying on them for food, transport, draft-power, labour and companionship. Domestication of animals also brings along with it the oppourtunities for the passage of pathogens from animals to man and vice versa. However, countless species of animals are also sources of viral, bacterial and parasitic diseases transmitted in many ways, including direct contact from them or water contamination by them.

In addition, infections which poses challenges to human health and welfare, originate either from animals directly or through their products and by-products. Hence human health is inextricably linked to animal health and production. This link between human and animal population and the environment is particularly close in developing countries. In both developing and industrialized regions, however this can lead to a serious risk to the public health with severe economic consequences.

About 75% of the new diseases (emerging zoonosis) that have affected humans over the past 10 years have been caused by pathogens originating from animals. Many of these diseases has the potential to spread through various means over long distances and become global problems (e. g. HPAI).

Approximately 80% of all described human diseases are from animals. For many diseases only circumstantial evidences for natural transmission is there so known as “suspected zoonosis” and epidemiology of many diseases is not sufficiently understood hence are called “masked zoonosis”.

Some humans are more at risk to zoonotic diseases than others e.g. infants and children (immature immune systems, poor hygiene) , pregnant women(immune systems are more susceptible and there are additional fetal hazards), elderly persons(immune systems may be impaired), immune-compromised people (undergoing cancer therapy, AIDS/HIV patients), people who have received organ

or bone marrow transplant , people born with congenital immune deficiencies, veterinarians ,farm families and other animal health care workers.

All major zoonotic diseases prevent the efficient production of food of animal origin, particularly of much needed protein and create to international trade in animals and animal by products.

Socio-economic aspect of Zoonosis

Zoonosis has been a social and economic burden. For many years and in many countries these diseases, with their reservoirs in domestic and wild animals, have imposed and are still imposing a very heavy burden, especially among the vast number of people living and working in rural areas.

The significance of zoonotic and parasitic diseases and related food-borne diseases, is growing continuously and their health and socioeconomic impacts are increasingly being felt by many countries and most particularly, although not exclusively, by developing countries. Apart from causing human suffering, morbidity and mortality, they hamper agricultural production, decrease availability of food, inhibit the generation of capital needed for investment and create barriers to international trade.

The great changes of the last decades, especially the increasing urbanization, most of which is inadequately planned, large movements of populations, opening up of badly needed new areas for food production, the increasing trade in meat, milk and other products of animal origin, the vastly increasing number and speed of vehicles, and even tourism have contributed to making the problem of zoonoses not only rural and characteristic of defined areas but regional and, in some cases, worldwide.

The developing countries suffer much loss than technically developed countries. This is attributable to the lack of adequately organized public health and veterinary services, poor hygiene, poor facilities for prompt diagnosis, poor standard of living and poverty and to particular social customs prevailing in the predominantly

agricultural societies of developing countries. Besides causing economic losses (related to treatment, immunization, loss of wages, loss of man- hours and man-power), morbidity and mortality in humans, zoonosis causes considerable loss of livestock, their productivity (dairy products, protein food, and animal by-product industries) and reproductivity. Thus zoonosis acts as a double-edged weapon affecting social fabrics and economic development.

The socio-economic losses of zoonoses though, significant, are difficult to quantify completely because completely because as with other human disease the actual costs in terms of lives and suffering cannot be measured. In addition the losses in export and investment opportunities and the consequent losses in foreign exchange by countries because of zoonoses cannot be estimated.

There are many features of zoonoses that render them particularly important to the developing countries and especially the poor whether they are livestock owners, labourers working with animals, livestock owners consuming products from their animals or non-livestock owners consuming these products.

First of these features is that many of these diseases produce fatal and disability in humans, the prevention of which is often through their control in animals. This requires the availability of appropriate veterinary and animal health technologies and their delivery to and accessibility by the people. Human sleeping sickness caused by *Trypanosoma brucei rhodesiense* is an important example in which mass treatment of cattle significantly reduces the risk of disease in humans. Another example is human epilepsy in which neuro- cysticercosis caused by the intermediate host of the pork tapeworm (*Taenia solium*) is considered the main cause.

The second feature is that while there are some zoonoses to which a large section of any given human population is equally susceptible the poor and the developing countries are at particularly at risk to many of them. Example include cysticercosis in pig in which poor sanitation is the underlying cause for which the knowledge and resources to adopt preventive measures are limited or absent. Another example is

Leptospirosis in which rats play an important role in the maintenance of infection and rats often thrive in poor and dirty environment.

The third and possibly the most important of these features is that the lower down the income scale, the more likely is the high risk of multiple zoonoses. Examples can be found in some rural and peri urban settlements where animals co exist with families struggling for survival. There is potential risk of human brucellosis and Tuberculosis from cow. The risk of multiple zoonoses is a factor poor purchase of cheap animals that may be culls of others or meat that have not been inspected, lack of knowledge and resources to protect their dogs from rabies.

PUBLIC HEALTH SIGNIFICANCE OF RODENTS, BIRDS AND INSECTS, CONTROL MEASURES AND SURVEILLANCE

Rodents

Rodents constitute a great hazard for both man and animals

(1) They eat/spoil farm grains
(2) Rodents kill birds especially chicks
(3) They damage building
(4) They cause offensive odour through their urine
(5) They spread diseases to man and his animals

Major diseases spread by rodents:

(1) Leptospirosis- *Ictero hemorrhagiae* (Weil disease): This is a primarily disease of dogs and rats. The disease is commonly transmitted to man by rat. Infection is commonly acquired by contact of skin or mucus membrane with urine, and to a lesser extent by intake of urine contaminated feed and water.

(2) Plague (Flea- Xeno)- This is a zoonotic disease involving rodents and their fleas which transfer the bacterial infection to various animal and to people. Plague is caused by *Yersinia pestis*. Wild rodents serve as natural reservoir of plague.

(3) Murine typhus fever/shop typhus/fleas borne typhus- This is a rickettsial disease caused by *Rickettsia typhi*. It is transmitted to man through infective rat fleas – Zenopsylla cheopis which defeacate rickettsiae while sucking blood, contaminating the bite site and other fresh skin wound.

(4) Rat bite fever- This is primarily an infection of rat caused by *Streptobacillus moniliformis* and *Spirillum minus*. Infection is transmitted by secretions of mouth, nose or conjuctual sac of an infected rat introduced by biting. Direct contact with rat is not necessary. Children under one year of age are most frequently involved.

(5) Lassa fever- This is an acute viral illness caused by Lassa virus (arenavirus), Wild rodents, the multimammate mouse *Mastomys natalensis* serve as natural reservoir. Transmission is primarily through direct or indirect contact with excrete if infected rodents deposited on surface such as floors, beds or in food.

Survey of rat and mice

(1) Rodent survey is the inspection of a rat infested area in order to assess the extent and size of infestation breeding places, openings whereby the rat enter the building, the species concerned and thereby determine the method of control suitable for the premises.

Method of Survey

(1) Trap and Catch – To determine type of rat/mice involved

(2i) Droppings – Examination of rat droppings will reveal whether the infestation is an old one or of recent one

(ii) Families of rat involved

(3) Runaways and Tracks – These are their travel routes

(4) Gnawed materials- These can be observed on wood or lead pipe

(5) Presence of holes, scrappy, nests, rat odour

Essential tips for rat control

(a) Establishment of rat control unit in large cities, rural areas and big companies

(b) Shelters for rats should be eliminated and garbage and waste which serve as food for rat should be disposed of hygienically

(c) All buildings should be rat proof

(d) Rat should be destroyed using poisoned baits and traps and fumigation of burrows done with the use of poisonous gases

Control Methods

(1) Sanitation- Appropriate storage and disposal of food, garbage and refuse is necessary to prevent access of peri-domestic rodents to food and shelter

(2) Physical methods

Rat proofing construction

(a) Concrete foundation to prevent rat burrowing

(b) Doors should be of metal/glass or good treated wood

(c) Openings around pipes passing through the wall should be sealed

(d) Wire mesh should be installed around window

(e) Install metal grids or gutters

3. Trapping- This is of limited use because rats are very prolific

Snap trap or brake-back trap can be used

4. Biological control- This involves elimination of pests by their natural enemies

- Introduction of cats and dogs into rat infested premise can control them to a certain level

Chemical control of rodents.

1. Synthetic inorganic- Zinc phosphide
   Arsenic pentomide
   Thallium sulphate
   Barium carbonate

2. Antigoaculant rodenticides Warferin and Congeners
Fumain, Fumasol and Tomorin
3. ANTU (Alpha Naphthylthiourea
4. Bromethalin
5. Cholecalcifecol
6. Phosphorus
7. Red squill (Cardiacglycoside)
8. Sodium Fluoroacetate (1080)
Sodium Fluoroacetamide (1081)
9. Zinc phosphide (Al phosphide)

Fumigants- Organic (Hydrogen cyanide)

Rat glue- Inorganic- Sulphur dioxide
Carbon monoxide

Glue is made up of resin and oil and underlying tissues by penetrating through the skin of animals and man.

Public Health importance of insects

Insect (Flies and Cockroaches)

Flies are a nuisance and a vector of diseases to both man and animals. Disease risk of adult flies lies in their feeding habit. Flies can only ingest fluid, they dissolve solid food by ejecting saliva on it. The saliva often contain bacteria and other micro-organisms from a previous meal, hence it will contaminate food.

Flies transmit diseases through the following means:

(1) Mechanically- Pathogens are transmitted through the mouth pars and feets e.g eggs of parasite worms, dysenteric amoebae, *Salmonella typhi* and *Vibrio cholerae* are disseminated through this.

(2) Vomitus and Excreta- By regurgitation and defeacation

Ingestion of whole insect- whole flies contains micro-organisms, eggs of trematodes, cestoda

Control of flies-

(1) Eliminate breeding sites

(2) Control fly entry to building-screen windows and doors

(3) Control of Flies inside Building- By the use of electrocuters and approved insecticides and use of baffle light traps

(4) Myiases- Fly larvae destroy the skin. - Flies associated with Myiasis are *Lucilia sericata, Hypoderma boui, Dermatobis hominis, Oestrus ovis*

Types of Myiasis

(1) Cutaneous myiasis

(2) Myiasis of cavities (nasopharyngeal cavity), skull sinuses, eyes (e.g *Chrysomyis*) auditory canal

Sarcophaga and *Callitrogea*

(3) Tissue myiases:

- *Oestrus ovis*
- *Hypoderma bovis*
- *Dermatobia hominis*

Cockroaches- These destroy and contaminate food contaminate water and spread disease causing agents like Salmonella, Clostridia and Staphylococci which may lead to food poisoning

Ham Skipper (*Piophila casei*)

- Eggs are laid on the exposed surface of meat
- Larvae damage the meat by eating part and creating holes in it
- The adult can carry Clostridium botulinum spores to contaminate food
- Ham Beetle (Necrobiarufipes)
- Adult beetle lay large number of eggs on meat surface
- Larvae so produced feed on the meat
- Larder Beetle (*Dermestes lardarius*) lay eggs on meat, particularly dried meat products

Chemical control of insect

The chemicals (insecticides) come in form of fogs, mists, sprays, powders and bait. Choice is determined by the area to be treated.

1. Non- Residual Insecticides

(a) Pyrethrims –This has a good knock down effect and safe. Available as spray e.g bioallethrin

(b) Allethrin- This can be used to control crawling insects- dellamethin

2. Residual insecticides

(1) Organochlorines- chloromated ethane - DDT – Dichlorodiphenyl trichloroethane

Cyclodienes- Chlordanes, aldrin, dieldrin, endrin and tozaphene

e.g. – Hexachloro cyclohexane, benzene hexachloride (BHC), lindane

(2) Organophosphates

- Coumaphos, diazinon, dichlorvos, malathion

Carbamates- cabaryl and propoxur

3. Formamidines (contraindicated in horses and cat) e.g amitraz

4. Citrus extract

Public Health and Economic Importance of Birds

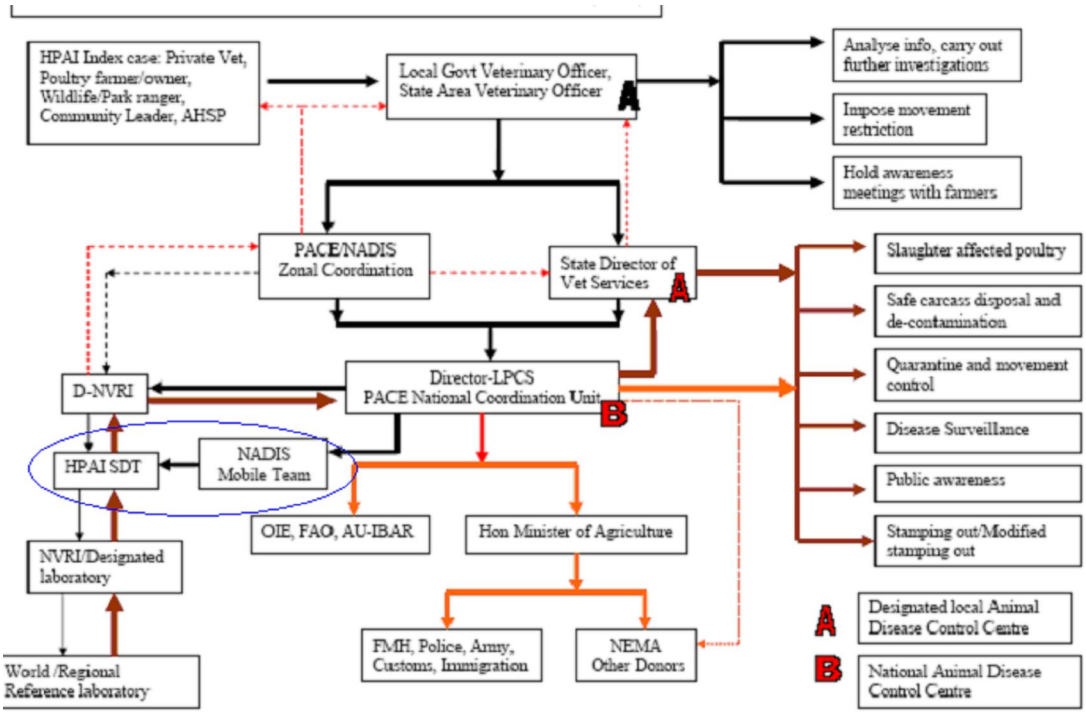
(1) Destroy or consumes foodstuff

(2) Carriers of diseases affecting man and animals e.g. Avian influenza by migrating birds

(3) Jeopardise safety in air craft

Control

- Proper husbandry techniques
- Trapping /shooting of large birds
- Aerial spraying of birds using chemical poison



WASTE MANAGEMENT

Objectives: At the end of this course the students should be able to:

1. Define waste management, disposal and utilization.
2. Know the importance of waste management.
3. Understand the various methods of waste disposal.
4. Know the advantages and disadvantages of each method of disposal.
5. Get acquainted with the process of Biogas production, its composition and application.

Definition of Terms.

- *Waste*: any material lacking direct value to the producer and so must be disposed of. The production of waste material is known as

the waste stream and includes the entire variety of refuse generated during domestic, industrial, construction and commercial processes.

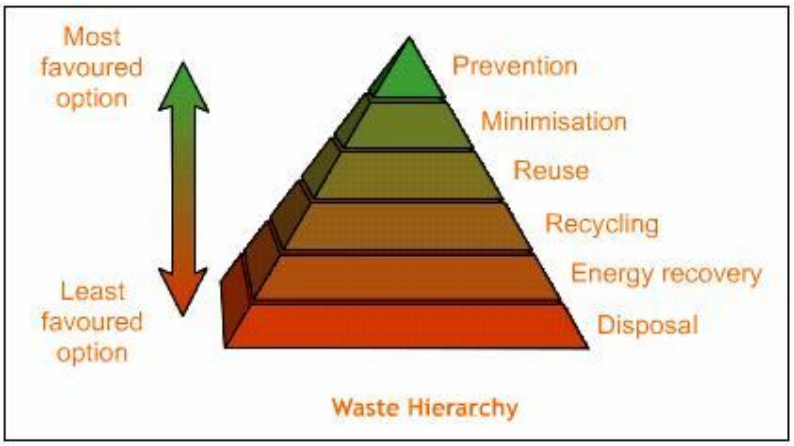
- *Waste management*: involves the collection, storage, transportation, processing, recycling or disposal of wastes and its monitoring. Waste management usually relates to materials produced by human and animal activities and is generally undertaken to reduce their effect on health environment or aesthetics. Waste management can involve solids, liquids, gaseous or radioactive substances with different methods and field of expertise in disposal management.
- *Waste disposal*: involves the collection of such in designated areas (disposal points) from where they are collected and transported for treatment or recycling. Waste disposal should be pollution free and must be done in an environmental friendly manner.
- *Waste utilization*: is the process of converting waste into useful products or resources e.g Biogas, Bioorganic fertilizers etc.

Importance of Waste Management

1. It prevents /alleviates environmental pollution or degradation which may result due to wastes generated by human and animal activities.
2. To protect human, animal and environmental health.
3. To recover useful and valuable resources that is beneficial.
4. Waste management plants or industries can serve to provide job opportunities or employment.
5. For aesthetics.

Waste Hierarchy

This refers to the "3RS " which are REDUCE, REUSE and RECYCLE which classify waste management strategies according to their desirability in terms of waste minimization. The aim of this is to extract the maximum practical benefits from products and to generate minimum amount of waste.



Methods of Waste Disposal

1. **OPEN DUMPS**: This is an uncontrolled surface disposal of waste (Cart the waste away) from some uninhabited areas such as fields, unused acreage or in water ways. This form of disposal is being widely discouraged but is still the most practiced in Nigeria and other developing countries. A slight improvement on this is to burn the waste but this still contributes to to air pollution in such environment.

Advantages

- Inexpensive
- Convenient

Disadvantages

- Disease organisms, rodents, flies, thrive in this environment hence constituting health hazards.
- Can result in air pollution
- Can cause ground water and run-off pollution

2. **SANITARY LANDFILL**: Disposing wastes in a landfill involves burying the waste and this remain a common practice in most countries. From public health point of view this was a major improvement on open dumping. Properly designed and well managed sanitary landfills are very hygienic while poorly managed ones can create a number of adverse environmental

impact such as wind blow litter, attraction of vermins and generation of liquid leachate which can contaminate surface/ground water.

Technology

A landfill is usually below ground level and is lined with an impervious material usually plastics to prevent leachates from escaping. It also contains a leachate removal system above. Once full it is capped with an impervious material such as clay cap to prevent the introduction of rain water that would increase the volume of leachate and breach the liner.

Advantages

- When properly managed it is hygienic and safe
- Not expensive to run
- Filled land can be reused for other community purposes.

Disadvantages

- Requires maintenance
- Needs proper planning, design and operations
- When poorly managed can lead to a lot of environmental impact such as odour problems, water pollution , green house effect, and may kill surface vegetation.

3. **INCINERATION**:

This is the burning of waste either solids, liquids, and is useful as an alternative heat source. The waste in incineration is burned in a controlled vessel where more complete combustion is achieved.

Advantages

- Requires minimum land
- Can be operated in any weather.
- Produces stable odour free residue

Disadvantages

- Expensive to build and operate

- High energy requirement
- Requires trained personnel
- Needs continuous maintenance

4. **COMPOSTING**

This is used in the production of compost manure. Waste materials which are organic in nature e.g. plant materials, animal manure and food scraps can be recycled using biological composting and digestion process to break down organic matter. In places where no better utilization of organic matter especially of animal origin is feasible, it can be composted to yield manure of reasonably good quality. Compost pits or bunkers can be made of bricks, coarse materials such as twig which are laid at the bottom for proper ventilation. Their alternate layers are laid up to 2 meters. The outside and top of the waste is protected by clean soil or grains.

Composting is a hygienic way of recycling nutrients of the organic by products of agricultural, urban and industrial activities. It is safe in storage and easily handled.

It is economical source of plant nutrients. Rather than cause environmental pollution properly composed organic material can be major asset in the enhancement of soil fertility, restoration of degraded solids and sequestration of carbon dioxide. Composting process for full carcass or significant quantities of waste takes several years is labour intensive and maybe inefficiently disposing hides and bones. Bones even chicken bones are notoriously difficult to compost.

5. **RECYCLING**

This is an important aspect of an efficient waste management system. Recycling turns waste back into useful and valuable products. Many non biodegradable materials are recyclable such as plastics papers, glass etc.

Advantages

- Conservation of natural resources.
- Reduction of waste.

- Creation of jobs which are free of health hazards
- Decrease emission of green house gases
- Helps to sustain the environment for the future generation

Other Methods

Burial: This method is used for dead animals and other meat production wastes by producers and abattoirs. The effects on water and soil and the risks of pathogen transmission have not been fully studied.

Rendering: This is a process applied to materials derived from slaughter, packing, processing food preparations and dead animals. It includes cooking, removing the moisture and separating materials into sterile animal protein.

Biogas

- Biogas is a combustible mixture of gases produced by microorganisms when livestock manure and other biological wastes are allowed to ferment in the absence of air or oxygen usually in an enclosed container.
- It is a methane rich flammable gas the result from the decomposition of organic waste material

Composition of Biogas

Compound	Chemical	%
Methane	CH_4	50-75
Carbon dioxide	CO_2	25-50
Nitrogen	N_2	0-10
Hydrogen	H_2	0-1
Hydrogen Sulphide	H_2S	0-3
Oxygen	O_2	0-2

Why use biogas?

- Main reason is to treat waste. These wastes are precious resources if used properly , but constitute major pollution when discharged into rivers and lakes.
- It removes pollution and mitigates global warming.
- Solves the most serious problems of energy supply in rural areas where people traditionally forage for fuel wood in the forest.
- Produces fuel for cooking, vehicles and is the cleanest biofuel available hence reducing respiratory problems and diseases.
- Can be used to generate electricity and heat. Hence prolong the active hours the day and enabling families to engage in social or self-improvement activities or earn extra income.
- Biogas also produces bio-slurry and bio-dregs rich in nutrients, minerals and this form excellent organic fertilizers for crops, fish and pigs.

Where does biogas come from?

- Vegetation
- Farm and ranch animals
- Sewage from human waste treatment plants

Biogas production

A biogas producing plant comprises of three components

- Digester- this is a tank where in fermentation occurs causing production of gas.
- Gasometer- A gas storage tank
- Pipes- for gas distribution at desired points.

The entire assembly has to be water and gas proof. The receptacle or inlets feed the digester with the waste and these undergo anaerobic fermentation. As a result biogas consisting of nearly 60% methane and 30% carbon dioxide and traces of H_2S and CO are produced.

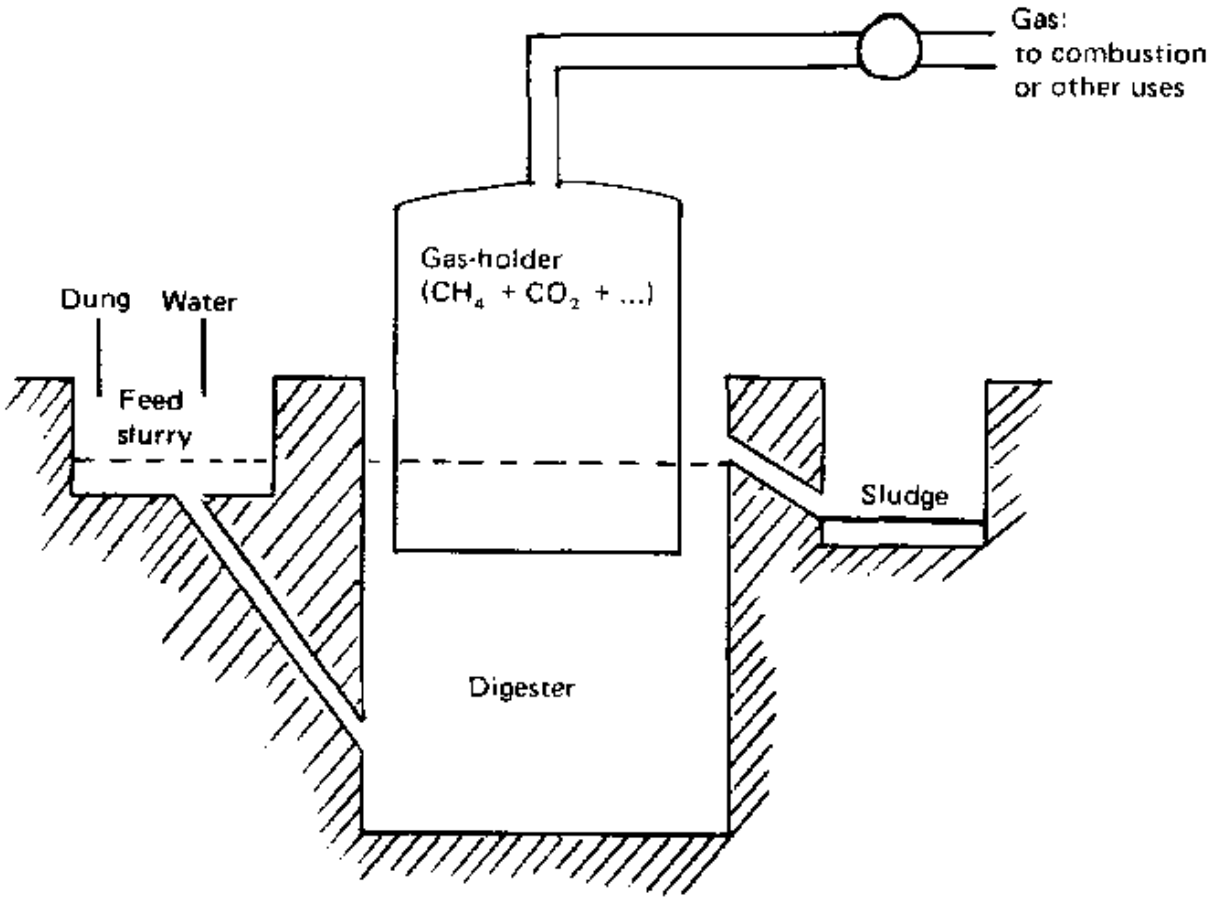


Diagram showing biogas production

ENVIRONMENTAL POLLUTION

Objectives: At the end of this class students should be able to

Define environmental pollution

- Know the roles of Veterinarians in environmental health/protection
- Know the types of environmental pollution
- Understand the impact on human, animal, and plant health.
- Understand the impact of animal husbandry and use of agrochemicals on the environment.

Environmental pollution is any discharge of materials or energy into water, land or air that causes or may cause acute (short term) or chronic (long term) detriment to the Earth's ecological balance or that lowers the quality of life.

This can also be defined as the unfavourable alteration of our surroundings whooly or largely as a by product of man's activities, through direct or indirect effect of changes in energy patterns, radiation levels, chemical and physical constitution and abundance of microorganisms. These changes may affect man directly or through his supplies of water and agricultural and other biological products, his physical objects or possession or his opportunities for recreation and appreciation of nature.

Until recently in humanity's history, where pollution has existed, it has been primarily a local problem. The industrialization of society, the introduction of motorized vehicles and the explosion of human and animal population however has caused an exponential growth in the productions of goods and services. Coupled with this growth has been a tremendous increase in waste by products.

The indiscriminate discharge of untreated industrial and domestic wastes into waterways, the spewing of thousands of tons of particulate and air borne gases into the atmosphere, the "throw away" attitude towards solid wastes and the use of chemicals e.g. pesticides without considering potential consequences have resulted into environmental disasters which include the climatic change due to global warming, increase natural disasters, outbreak of diseases and zoonoses, etc.

Types of Pollution

All types of pollution have an impact on the living environment. The effect on living things may range from mild discomfort to serious diseases such as cancer to physical deformities. Pollution can also cause psychological and behavioral disorders in people.

The following are the types of pollution:

- Water pollution
- Air pollution
- Soil pollution

Water Pollution

This is the introduction into fresh or ocean water of chemical, physical or biological materials that degrades the quality of water and affects the organisms living in it. This process ranges from simple addition of dissolved or suspended solids to discharge of toxic pollutants such as heavy metals, pesticides, etc.

Effect on animals:

- There may be nutrient pollution (Nitrogen, phosphate e.t.c) which causes overgrowth of toxic algae and when eaten by other aquatic animals may cause death or outbreak of fish diseases.
- Contamination of water by chemicals e.g oil can negatively affect development of marine bodies, increase susceptibility to diseases, liver and kidney damage as well as nervous. Mercury in water can cause reduced reproduction, death and extinction.

Effects on plants:

- May disrupts photosynthesis in aquatic plant thus affecting the ecosystem that depends on the plant
- Terrestrial and aquatic plants may absorb pollutants and pass up the food chain to consumers.
- Plants may be killed by chemicals such as sodium chloride or pesticides in water.

Effect on humans:

- Water borne diseases when drinking water gets contaminated e.g. typhoid, amoebiasis, Giardiasis, Hepatitis, e.t.c.
- Water diseases such as rashes, pinkeye, E coli O157:H7 infection, other gastroenteritis e.t.c. can be got from contaminated beaches.
- Chemical pollutants in water such as pesticides, heavy metals can cause cancer, hormonal problems, kidney, DNA, nervous, and kidney damages and death.

Air Pollution

This is the accumulation in the atmosphere of substances that, in sufficient concentrations endangers human health or produces other measured effects. Among major sources of pollution are power and heat generation, burning of solids, industrial and agricultural processes and especially transportation.

Effects on humans:

- Reduced lung functioning
- Irritation of eyes, nose, mouth and throat
- Asthma attacks
- Respiratory symptoms e.g. coughing and wheezing
- Bronchitis
- Headaches and dizziness
- Cardiovascular problems
- Cancer
- Premature deaths

Effects on animals:

- Acid rain(formed in the air) destroys aquatic life in lakes and streams
- Ozone in the lower atmosphere may damage lung tissues
- Excessive ultra violent radiation from the sun through ozone layer that has been depleted can cause skin cancer.

Effects on plants and trees:

- Acid rain can kill trees, destroy leaves and infiltrates the soil by making it unsuitable for nutrition and habitation.
- Ozone in the lower atmosphere can prevent photosynthesis rates which can stunt plant growth.

Soil Pollution

This is the degradation of the earth's land surface through misuse of the soil by poor agricultural practices e.g. soil erosion, mineral depletion, industrial waste dumpingand indiscriminate disposal of urban wastes.

Effects on Humans:

- Cancer e.g. Leukemia
- Lead in soil is especially hazardous for young children because of brain damage.
- Headaches, eye irritations skin rashes.

Effect on plants:

- May alter plant metabolism and reduce crop yield.
- Trees and plants may absorb soil contaminants and pass them up the food chain.

Effect on animals:

- Small life forms may consume harmful chemicals which when passed up the food chain to large animals may lead to increase mortality and animal extinction.
- Can alter metabolism of microorganisms and arthropods in a given soil environment. This may destroy some layers of primary food chain and have adverse effect on predators' animal species.

IMPACT OF USE OF AGROCHEMICALS ON THE ENVIRONMENT AND PUBLIC HEALTH.

What are agrochemicals? These re chemicals used for agro industries for the control of pests and vectors of diseases in both animals and plants.

Pesticides used for these purposes are divided into 2 different types which are herbicides and insecticides e.g. DDT.

Agrochemicals and the environment

These are essential to help to intensify crop production and reduce the effect of pests, parasites as well as vectors causing diseases to farm animals. These chemicals can however be easily washed into streams or infiltrate the soil, eventually contaminating ground water reserves. Pesticides can be transmitted over a long distance by wind or water. This entails that the possibility exists for them to accumulate in aquatic and marine food chains far from the site of application.

Agrochemicals threat to human health

Have you ever wondered why you might have at times experienced stomach problems after taking some water? This experience may be as a result of consumption of polluted water. Chemical pollutants pose a major threat to public health through poisoning. In both fresh and marine water, algae can multiply rapidly or bloom when there is sudden increase in the nutrients of the water particularly nitrates and phosphates. This contaminated algae in turn become an important source of food for fresh water and marine animals. Toxic algal blooms have a variety of effects on the public health. In some cases people experience the signs of acute diarrhea and even death when they eat fish or animals contaminated with these chemicals.

In what ways can humans be exposed to these chemicals?

Agricultural chemicals such as pesticides and herbicides may be taken into human body by the mouth, skins or through the lungs. The uptake of chemical poisons during application is minimal unless operators unwisely eat, drink or smoke before washing hands and face. Oral poisonings usually occur through accidental exposure i.e. when pesticides are improperly stored in food containers or drink bottles. Other incidents of pesticide poisoning usually occur when recently sprayed fruits have been eaten or when chemicals are taken intentionally in case of suicide.

Contamination of the body takes place principally by absorption through the skin which is particularly vulnerable where there is cut or skin break. Remember the back of the wrists absorbs chemicals more than the palms. Also the eyes, neck, feet, armpits and groins are areas that need more protection. The risk of skin absorption is more in hot weathers when sweating occurs.

Safety precautions and Protective covering

Safety precautions to be taken in using agrochemicals depend on the hazard involved in transportation, storage and use of a particular chemical, the level of toxicity that varies according to their chemical structure, purity and formulations. The risk of poisoning by more toxic chemicals can be reduced by suitable formulations and packaging. Increasing emphasis is given to the design of application equipments that minimize the risk of exposure of the operator.

Agrochemicals must be stored in safe places and used according to instructions. The first thing the user of agrochemicals must do is to read the label and adhere to the instructions accordingly.

Protective covering

Appropriate protective coverings must be worn when pesticides are to be applied. The minimum protective covering is an overall defined as a single garment fastening at the neck and wrists.

A safe protective covering (P.C.) must meet the following criteria:

- It must cover the whole body and must also include the face shield, goggles, respirator, footwear or gloves.
- Must have sleeves over the top of the gauntlet gloves unless elbow- length gloves are needed for dipping plants or animals in pesticides/acaricides.
- It must be resistant to penetration by liquid or solid particles in the circumstances in which it is being used and minimize thermal stress to the operator who wears it.

It is advisable to wash P.C. preferably at the end of each days spraying after all the equipment has been cleaned and stored.

IMPACT OF ANIMAL HUSBANDRY ON THE ENVIRONMENT AND HUMAN HEALTH.

Livestock farms also known as feedlots house thousands of cows, chickens or pigs produce staggering amount of animal wastes. The way these wastes are stored and used has profound effects on the humans and the environment.

Animal husbandry and activities has generated so much waste and environmental pollution e.g. 60 million hogs or pigs in the U.S.A produce an estimate 100 million tonnes of faeces and urine. Also 46.5 million milk and beef cows produce 500 million tonnes of waste per year. This has contributed to waste spills which have in turn introduced enteric pathogens into surface water. The wastes generated also contaminate ground waters with nitrates, air with ammonia and odour so offensive that could affect people psychologically.

Agricultural wastes disposal into lagoons and lakes also contribute to increase nutrients in them. This encourages the growth of algae which utilizes the oxygen to give carbon dioxide. Continuous utilization of the dissolved oxygen could cause depletion of oxygen which has an adverse effect on the aquatic bodies hence resulting into death (asphyxiation). In addition the risks of lagoon leakage, overflow and discharge pose direct treat to quality of soil and water systems. A survey carried out between 1986-1998 by CDC demonstrated that in every case where the pathogen could be identified most likely originated from livestock.

In addition, livestock wastes when it contaminates ground water increases the nitrate level of the water. Drinking water with nitrate concentrations above recommended increase the risk of blue baby syndrome in infants below 6 months

which can result in infants death as a result of oxygen deprivation. High levels of nitrates in drinking water close to hog factories have also been linked to spontaneous abortions.

In addition wide uses of antibiotics also pose dangers to the environment and human health. Large scale animal factories often give animals antibiotics as growth promoters or to compensate for illness as a result of overcrowding and poor hygienic practices. Such antibiotics can get into the environment and food chain hence resulting into antibiotic resistance in humans.

Another effect is the green house effect. Livestock wastes has been implicated in green house emissions of green house gases such as methane, carbon dioxide, nitrous oxide gases which has been found to influence global climate change as well as regional soil quality.

Also storage of animal wastes under industrial livestock facilities has been found to pose health risk to both animals and humans. This can lead to death in animals due to poor ventilation and build up of toxic gases.

In humans, death of workers in livestock facilities has also been reported due to build up of toxic gases and respiratory complications.

PREVENTION OF ENVIRONMENTAL POLLUTION

Practical remedies to these problems do exist. But implementing them will require some important changes in animal husbandry practices and government oversight.

- Public awareness and participation: Local government and the residents should have a say in whether to allow farms it their communities. The public is also entitled to review and comment on the contents of pollution reduction plans and to enforce the terms where a factory farm is in violation.
- Regulation and accountability: Factory farms should be taken as industrial facilities and should be regulated accordingly. They must be registered,

obtain permits, monitor water quality as well as pollution and observe proper cleaning ,disposal and management of their wastes.

- New technology: Animal farm technology standards must be strengthened and encouraged. The FEPA must consider recent technology advances that significantly reduce pathogens and pollution.
- Pollution reduction programs in small farms: Voluntary programme must be expanded to encourage smaller factory farms which fall outside of the regulation for industries, to improve on their management practices.